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A way to save the levee habitat?

A UC Davis study finds plants benefit flood safety

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Monday, July 16, 2007

The U.S. Army Corps of Engineers insists that virtually all vegetation be removed from California levees to protect their structural integrity.

But a novel study at UC Davis -- using the largest hydraulic research flume west of the Mississippi -- is bolstering years of scientific findings that show trees and shrubs may actually improve flood safety.

For decades, the corps allowed large vegetation on California levees, in coordination with wildlife agencies, for the sake of habitat. Unlike many other major American rivers, California's big rivers are squeezed into narrow channels, making levees themselves vital habitat for fish, birds, other wildlife and people.

But in February, the corps enforced strict national vegetation guidelines in California for the first time. These rules essentially allow nothing but short grass to grow on levees.

Thirty-two California levee districts were told in February that they failed the standard. More are likely to fail when another inspection occurs this fall, including Sacramento's urban levees.

The corps is updating its national policy but the final outcome is uncertain, forcing levee and wildlife officials into a waiting game. It is unclear if the corps is taking into account the new UC Davis findings.

In the meantime, on June 12, the corps released interim guidance for local levee districts that essentially reinforces existing national policy. Only short grass can grow on the land side of levees. Nothing over two inches tall can grow on the water side.

Districts must remove all vegetation by March 30, 2008, or the corps says it will cut access to millions of dollars in federal levee funds available following flooding.

If districts do comply, hundreds of miles of California riverside habitat could be wiped out.

"It really is sort of a recipe for disaster in levee maintenance here," said Mike Hardesty, president of the California Central Valley Flood Control Association, which represents dozens of levee

districts.

The corps policy stems from a belief that plants hinder levee inspection and reduce flood channel capacity. The agency also believes roots destabilize levees and create a path for seepage.

But years of research have shown just the opposite.

In a flume that simulates a floodway such as the Yolo Bypass, a team at the UC Davis Amorocho Hydraulics Laboratory runs giant pumps to move water across a field of willow shrubs anchored underwater. Sensors and cameras monitor water flow and plant movement.

The flume -- about 80 feet long with a cross-section similar to a standard doorway -- also is home to dozens of young chinook salmon, monitored by cameras peering through glass panels.

The study found that the willows flatten against the ground surface as flows increase, offering little resistance to water flow. The bent shrubs protect the soil from erosion and create a bottom layer of slower water. The young chinook salmon seek refuge in this calm bottom layer among the flattened willows.

"The benefits start kicking in at high flows when flood risk is worse," said Stefan Lorenzato, who is leading the study along with UC Davis researchers. Lorenzato is a watershed management coordinator at the California Department of Water Resources. "It's implying that plants may be helping us, not hurting us."

He acknowledged the study simulates a floodway and not a levee system, where flows are stronger and more variable. But he said it provides the first hard data on plant behavior in a flood.

Engineers now rely on assumptions in computer models to decide how plants affect flooding.

But Joe Countryman, president of MBK Engineers, a Sacramento firm that designs flood-control projects, said these models don't account for the reduced friction that occurs when plants "lay down" under high flows. Nor do they consider that plants may reduce erosion.

"To me, this is pretty exciting research," said Countryman.

"Really, one of the biggest threats to the flood system is not (channel) capacity, it's erosion. To the extent this demonstrates that plants slow erosion, that's a real plus."

Earlier research on the Sacramento River found no evidence that tree roots compromise levee strength or allow floodwaters to seep through levees.

Douglas Shields, a hydraulic engineer at the U.S. Department of Agriculture Sedimentation Laboratory in Mississippi, studied a 35-mile stretch of the Sacramento River before and after the 1986 flood, the biggest on record.

He found levees with trees suffered less damage than those

without them. He also found that trees did not impair levee performance. Levee vegetation, he reported in a 1991 study, may have increased soil strength by deflecting high-velocity water.

Other researchers found similar results after a 1993 flood on the Missouri River.

And in 1992, Shields studied a 10-kilometer stretch of the Sacramento River across from Natomas where large oak and cottonwood trees grew.

By measuring root density, he found no evidence that trees compromised levee strength or caused "piping" of water along roots. Instead, roots tended to strengthen levees by binding the soil, and also grew downward, helping strengthen levees from within, rather than growing sideways. In all cases, roots were shallow: almost no large roots grew deeper than about three feet.

The main threat he found was the danger that large trees could topple in high winds, potentially removing a section of levee. The results, he said, suggest a need for vegetation policies tailored to different situations.

"My work tends to provide an argument against a uniform policy," said Shields.

He will present his research at a symposium on levee vegetation Aug. 28 and 29 sponsored by the Sacramento Area Flood Control Agency.

Meegan Nagy, emergency manager for the Sacramento District of the Corps of Engineers, said her headquarters will probably finalize vegetation rules within a few months.

An exception is possible for sections of the Sacramento River where a unique flood operations manual actually encourages vegetation to prevent erosion. But even here, trees and other plants may still have to be cleared on the dry side of levees.

"The best solution is the one that protects public safety while also preserving natural resources," said Nagy. "In some cases, that's going to be difficult, and in other cases it's not going to be difficult."

State officials this spring attempted a rough inventory of levee vegetation during routine inspections. Inspectors found trees on 457 miles of Central Valley levees. Shrubs and other vegetation were found on 830 miles of levees.

"To uniformly remove all of it, if you put that in dollars and cents, it would dumbfound you," said Shields. "The evidence for adverse ecological impacts is overwhelming."

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